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Publication date:
2018

Document Version
Version created as part of publication process; publisher's layout; not normally made publicly available

Combining circularity and LCA: Quality assessment and substitutability of recycled plastic from household waste

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Keywords: Plastic recycling; quality assessment; substitutability; circular economy

In recent years, the concept of circular economy has gained attention as a strategy to counteract resource depletion and ensure sustainable development. A primary focus of the circular economy is to recirculate materials, thereby closing material loops, as opposed to losing them through incineration or landfilling. Consequently, recycling has been highlighted as a crucial measure in the transition towards circular economy, which has led to recycling targets for several waste material fractions in the EU. One of these materials is plastic for which specific strategies has been completed, emphasising the importance of quality of recycled plastic. The quality aspect is especially important regarding plastic from household waste (HHW), as this is a highly contaminated and heterogeneous waste stream. As a large share of the plastic products in the HHW is high-quality food packaging, recycling of plastic HHW to lower quality does therefore only contribute to partial closing of the plastic loop, because virgin plastic is still needed for the production of high quality plastic. This aspect needs to be taken into consideration, so the most circular waste management options can be identified. The aim of this presentation is to present a method for substitutability estimation that takes the aspect of quality and circularity of recycled plastic from HHW into account.

The method focuses on waste plastic streams from HHW prepared for recycling and includes two steps: 1) quality assessment and 2) substitutability estimation. In step 1, the waste plastic stream in question is assigned either high, medium or low-quality, based on knowledge related to the degree of contamination. The quality levels are linked to the potential applicability, in the sense that a waste plastic stream assigned high-quality has the potential to be used in food packaging (complying with comprehensive legislation), whereas medium-quality at best can be used in toys, pharmaceuticals and electrical and electronics (applications regulated to varying degrees), and low-quality streams can at best be used in building and construction, non-food packaging, automotive and others (applications not regulated).

In step 2, the substitutability (also called substitution ratio or B-factor) is estimated based on the assigned quality and the European market share related to the applications in which the plastic has a potential to substitute virgin plastic. As an example, 57% of the European PET is used to produce food packaging. If a PET stream from HHW is found to be medium-quality, meaning that it cannot be used for food-packaging (which requires high-quality), it does not have the potential to substitute virgin plastic in these 57% of the PET market and can therefore not close this part of the PET loop. Thus, such PET HHW streams are assigned a substitutability of 0.43 (=1-0.57).

Consequently, due to the high level of food packaging in plastic HHW, only recycling where the plastic waste have the potential to be recycled into high-quality plastic contribute to the full circularity of plastic from HHW. This is especially important for PET and LDPE HHW streams, as more than 50 % of the European PET and LDPE markets are used for food packaging.